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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re application of:

TAGUCHI ET AL

Application No.:	09/642,765	Art Unit:	1725
Filed:	August 22, 2000	Examiner:	C. Cooke
For:	LEAD-FREE SOLDER PASTE FOR REFLOW SOLDERING		

REPLY BRIEF

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

The Examiner's Answer mailed on August 22, 2003 in connection with the present application presents a number of new arguments to which the Applicants would like to respond.

1. Page 13 of the Examiner's Answer contains a new argument concerning Issue 2 of the Appeal Brief, which is the rejection of claims 1 - 24 under 35 USC 103(a) over Paruchuri in view of Sakai. In order to understand the new argument, it is necessary to briefly review the references and the grounds of rejection.

As set forth on page 15 of the Appeal Brief, Paruchuri

discloses a lead-free solder paste including a primary solder powder and an additive powder component. Paruchuri states in column 3, line 64 that Cu represents 3 - 10% of the total metal weight of its solder paste, and in the Examples of Paruchuri, all of the pastes have a Cu content of 5.5 wt % or above.

Sakai discloses a lead-free solder for joining electronic parts. According to one embodiment of Sakai, the lead free solder alloy contains 92 - 97% Sn, 3 - 6% Ag, and 0.1 - 2% Cu.

According to pages 10 and 11 of the Official Action of October 17, 2002 (which contains the rejections being appealed), it would have been obvious to have modified the solder paste taught by Paruchuri to employ the composition taught by Sakai with a Cu content of 0.1 - 2%.

It had been the Applicants' understanding that the Examiner was proposing in the Official Action to modify the Paruchuri reference by modifying the additive powder component of Paruchuri to achieve a certain Cu content, with no change in the primary solder powder employed by Paruchuri.

However, page 13 of the Examiner's Answer contains the following statement:

> "Sakai et al. is relied upon to modify that part of the Paruchuri et al. alloy that is the Sn alloy powder, not the elemental additive powder."

While the meaning of this statement is not completely clear to the Applicants, the Examiner appears to now be stating that it would be obvious to modify Paruchuri by replacing the primary solder powder of Paruchuri with an Sn-Ag-Cu alloy taught by Sakai. Namely, it appears that the Examiner is proposing to

modify the primary solder powder of Paruchuri, not the additive powder component.

This proposed modification of Paruchuri is not reasonable because there is no teaching in the references which suggests that such a modification would provide any beneficial effects.

Of all the alloys which Paruchuri discloses as being usable as the primary solder powder (the principal examples being a Sn-Ag alloy or a Sn-Pb-Ag alloy), none of the alloys contains copper. In the multiple-powder solder paste of Paruchuri, copper is present only in the additive powder component, in which it remains in an unmelted, unalloyed state after soldering. There is no suggestion in Paruchuri that copper provides any benefit in its composition except when present in the additive powder component. Thus, there is nothing in Paruchuri that would lead a person skilled in the art to employ a Sn-Ag-Cu alloy as the primary solder alloy in its composition.

Sakai teaches a Sn-Ag-Cu alloy for a solder paste containing 0.1 - 2% of Cu. Sakai's teachings pertain solely to a single-powder solder paste, and there is no indication in Sakai that the benefits of a certain composition in a single-powder solder paste have any applicability to a multiple-powder solder paste of the type to which Paruchuri pertains. With a multiple-powder solder paste like that disclosed in Paruchuri, the properties of a joint formed using the paste are only partially determined by the composition of the primary solder powder and are also determined by the additive powder components. Since Sakai does not discuss anything about using an Sn-Ag-Cu solder alloy as the primary

solder powder in a multiple-powder solder paste, no one skilled in the art could predict from the teachings of Sakai what the effect would be of using a solder like that disclosed in Sakai as the primary solder powder of Paruchuri together with an additive powder component, which is required by Paruchuri. For this reason, there is also nothing in Sakai that would lead a person skilled in the art to employ the Sn-Ag-Cu alloy of Sakai as the primary solder alloy in the composition of Paruchuri.

Thus, there are no teachings in either of the references that would lead a person skilled in the art to make the modification of Paruchuri proposed on page 13 of the Examiner's Answer. Since the references lack the requisite teachings, they fail to provide any motivation for the proposed modification, and as there is no motivation, the proposed modification cannot be obvious.

2. Page 14 of the Examiner's Action contains the following statement concerning Issue 2 of the Appeal Brief: "Thus, it appears the applicant supports the fact that "combinations thereof" is broad but would encompass a more specific type of combination, i.e. an alloy." The Applicants wish to emphasize that they do not in any way agree with or otherwise support the Examiner's interpretation of the language "combinations thereof" as used in Paruchuri. The Applicants' position concerning the meaning of "combinations thereof" in Paruchuri is as set forth on pages 18 - 20 of the Appeal Brief. Namely, the expression "combinations thereof" is an ambiguous expression which is used

by different writers to mean different things. Looking at the context in which the expression is used in Paruchuri, the only reasonable interpretation for that expression is that in Paruchuri it refers to a physical mixture of two or more elemental powders and does not refer to an alloy. Thus, the Applicants' position remains that Paruchuri never contemplates a lead-free solder paste containing two Sn alloy powders.

3. At the bottom of page 14 of the Examiner's Answer, the Examiner dismisses the Applicants' arguments presented on pages 20 - 22 of the Appeal Brief concerning the allowability of claim 3, without appearing to have actually considered the merits of those arguments. The Applicants believe that those arguments are worthy of full consideration, since they are probative of the allowability of claim 3.

In establishing a *prima facie* case of obviousness, it is imperative that the prior art references teach or suggest all the claim limitations. See, for example, MPEP 2141.03. The Applicants' arguments on pages 20 - 22 of the Appeal Brief demonstrate that the cited references (Paruchuri and Sakai) do not teach or suggest all the limitations of claim 3. As set forth in those arguments, combining Paruchuri and Sakai references in exactly the manner proposed by the Examiner can result in an infinite number of compositions (such as hypothetical Paste A and Paste B described at the bottom of page 21 of the Appeal Brief) which <u>do not satisfy</u> all the limitations of claim 3. Therefore, merely combining Paruchuri with Sakai as

proposed by the Examiner does not automatically result in a solder paste having all the features set forth in claim 3. As the references do not contain teachings from which a person skilled in the art could select the compositions for the individual Sn alloy powders set forth in claim 3, the references do not teach all the features of this claim and so cannot render it obvious. The Examiner appears to have felt it appropriate to ignore the arguments on page 20 - 22 of the Appeal Brief because, as stated on page 14 of the Examiner's Answer, hypothetical Pastes A and B "are not drawn from any of the cited references or the instant application". The fact that Pastes A and B are not drawn from the references is a logical result of the fact that the Examiner is making an obviousness rejection of claim 3, and thus any composition resulting from a combination of the references is necessarily a composition which is not taught by the references. The fact that hypothetical Pastes A and B do not fall within the scope of claim 3 is the very significance of these examples, since they show that combining the references in the manner in which the Examiner has proposed does not automatically result in the solder paste of claim 3. Thus, the Applicants' arguments on pages 20 - 22 of the Appeal Brief are highly relevant, and if properly considered, show why claim 3 must be allowed.

4. In the remarks on pages 20 - 21 of the Examiner's Answer concerning claims 20 and 24, the Examiner appears to have misunderstood the language of these claims and has inaccurately

described both the Kazem-Goudarzi reference and the Applicants' explanation in the Appeal Brief of the difference between claims 20 and 24 and Kazem-Goudarzi. The Examiner's position appears to be that there is no difference between the method steps recited in claims 20 and 24 and the steps in the method employed in Kazem-Goudarzi. The Examiner's position is erroneous, because there is a clear distinction between the steps performed in these claims and the steps performed in Kazem-Goudarzi.

Claims 20 and 24, which ultimately depend from claims 3 and 18, respectively, each describe a method including completely melting a plurality of metal powders (defined in claim 3 or claim 18, respectively) in a single reflow step. Kazem-Goudarzi does not teach or suggest such a method.

Kazem-Goudarzi describes a soldering process in which a dual-alloy solder paste containing two different types of solder particles is melted in two reflow steps. (Kazem-Goudarzi refers to its paste as containing "particles", while claims 20 and 24 refer to a paste containing "powders", but the particles employed in Kazem-Goudarzi appear to be of a size which could be described as being a powder, so in this discussion, the terms "particle" and "powder" will be used interchangeably.) As schematically shown in Figure 2 of Kazem-Goudarzi, the dual-alloy solder paste employed in that reference is initially a mixture of particles of a low temperature alloy 115, particles of a high temperature alloy 120, and additional components 118 (fluxes or vehicles). During a first reflow step described in column 4, lines 48 - 51, the solder paste is heated to a temperature such that the low

temperature alloy 115 is melted or liquified and such that the high temperature alloy 120 remains in its original unmelted state. When the low temperature alloy 115 is allowed to solidify, what results is an aggregate-like structure of particles of the unreflowed high temperature alloy 120 distributed within a matrix of the reflowed or melted low temperature alloy 115. After the low temperature alloy 115 has solidified, it is no longer in the form of particles, since it has been converted into a solid solder mass (column 4, lines 57 - 58). This fact is clearly shown by Figure 3 of Kazem-Goudarzi, which illustrates the low temperature alloy 115 as a continuous body rather than as particles (in contrast with the initial state shown in Figure 2, in which the low temperature alloy 115 is clearly shown as being in the form of particles). Figure 3 illustrates the phenomenon, well known to those skilled in the art, that when solder particles in a solder paste are melted during reflow, they are converted from particles into what has been colorfully described in scientific literature as "a coherent blob of solder". See Ralph Woodgate, The Handbook of Machine Soldering, p. 212 (John Wiley & Sons, 1996).

In a second reflow step, the aggregate-like structure of Figure 3 is then heated to remelt the low temperature alloy 115 and then to melt the high temperature alloy 120 for the first time. What results is a third alloy 200 which is essentially uniform throughout, as shown in Figure 4.

During the second, high temperature reflow step, since the low temperature alloy 115 is no longer in the form of particles

(or powder), the only solder particles which can be melted are particles (powder) of the high temperature alloy 120. Thus, the only particles (powder) which are melted in the first reflow step are particles (powder) of the low temperature alloy 115, and the only particles (powder) which are melted in the second reflow step are particles (powder) of the high temperature alloy 120. In each reflow step, only one type of particle (powder) is melted. It follows that Kazem-Goudarzi never melts a plurality of different types of powders in a single reflow step, as set forth in claims 20 and 24, and the statement on page 21, line 4 of the Examiner's Answer that "The art indeed teaches that the plurality of metal powders are completely melted in a single reflow step," is contrary to the disclosure of Kazem-Goudarzi.

The Examiner appears to have overlooked the word "powders" in claims 20 and 24. Claims 20 and 24 both require that the plurality of different substances which are melted in a single reflow step <u>each</u> be in the form of a powder (particles) during the <u>single reflow step</u>. As set forth above, in Kazem-Goudarzi, only a single type of particle (powder) is melted in each reflow step. The second reflow step of Kazem-Goudarzi does involve melting two different solder alloys, but <u>only one</u> of the solder alloys (the high temperature alloy 120) is in the form of particles (a powder) at this time. Claims 20 and 24 are clearly distinguished from such a process, since these claims recite completely melting a plurality of metal powders (particles) in a single reflow step, not merely melting a plurality of different metals.

The methods described by claims 20 and 24 in which a plurality of different metal powders are melted in a single reflow step enables reflow of a multiple-powder solder paste to be carried out in a simple, efficient manner while at the same time preventing the occurrence of tombstoning of semiconductor chips, which is a problem frequently experienced in reflow soldering. In contrast, the method of Kazem-Goudarzi is more complicated, since it requires two heating steps, and there is no indication that the method is capable of preventing tombstoning. Thus, the method described by claims 20 and 24 is not only patentably distinct from the method employed by Kazem-Goudarzi, but it provides advantages not taught by the cited reference.

5. With the exception of the above points, the Examiner's Answer does not appear to present any arguments which have not already been addressed in the Appeal Brief.

6. The last page of the Examiner's Answer indicates an old correspondence address for the Applicants. The current correspondence address, of record in the present application since May of 2002, is listed below. Updating of the address is kindly requested to avoid future correspondence being

inadvertently sent to the wrong location.

Respectfully submitted,

Michael Tobias

Michael Tobias
Registration Number 32,948

#40
1717 K Street, N.W., Suite 613
Washington, D.C. 20036
Telephone: (301) 587-6541
Facsimile: (301) 587-6623
Date: Oct 15 2003